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SEVENTH FRAMEWORK PROGRAMME

FUTURE NETWORKS

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Executive summary

UniverSelf intends to become a trendsetter in the area of autonomic networking for future networks. To this end, the work package 5 of the project coordinates all the dissemination, promotion and standardisation activities aiming at ensuring a wide impact and take-up of the project's vision and outcomes.

The present document is an outcome of the four tasks constituting work package 5 of UniverSelf. It reports all the trendsetting activities, achieved in the previous period (from September 2010 to October 2012). It covers: publications, presentations, communication, project promotion, event organization (workshops, panels and special issues), prototype demonstrations, liaisons and collaboration with other projects and standardization actions.

The main trendsetting achievements of UniverSelf, which are detailed in this document, are:

- A total of 105 scientific publications: 83 published or accepted for publication, 22 submitted for review.
- Public release of 12 major technical reports, 8 white papers and 2 general project promotion publications: the project leaflet and a first press release; in addition to project and demo posters.
- Set-up and maintenance of an active web presence, which is referenced by Wikipedia.
- Release of five of the first standards with contribution and influence from the UniverSelf project: Y.3001 recommendation approved in May 2011 by ITU-T, Y.3011 recommendation approved in January 2012 by ITU-T, Y.3021 recommendation approved in January 2012 by ITU-T, AFI-001 group specification approved in May 2011 by ETSI and AFI-002 group specification to be approved in November 2012 by ETSI.
- Planning, monitoring of and participation in standardisation or pre-standardisation group meetings.
- Demonstration of the first UMF-compliant prototypes and network empowerment mechanisms at 3 widely-attended events.
- Organisation of relevant dissemination events and activities: workshops and special sessions (7); special issues (2); and active participation in events with European Commission support.
- Collaboration with other EU-funded projects and international research initiatives (12).
- Preparation and planning of open-source solutions for management of future networks: 2 platforms under development at UCL and INRIA.

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1 Introduction

UniverSelf intends to become a trendsetter in the area of autonomic networking and self-management for future networks. To this end, work package 5 of the project concentrates all the dissemination, promotion and standardization activities aiming at ensuring a wide impact and take-up of the project's vision and outcomes. The members of the UniverSelf consortium have strong links to all of the Future Internet constituencies and to relevant standardisation organisations; hence, the project, through work package 5, foresees to exploit these relations as much as possible. The main objectives are:

- To disseminate project results to project partners (to gain feedback and seed collaboration), to industry (to encourage take up of the technology) and to the wider community.
- To communicate with other related initiatives and Future Internet projects working in similar areas to ensure that achievements have a concrete impact.
- To build and establish community-wide understanding and acceptance of valuable project outcomes, regarding in particular certification and trust mechanisms for self-managing networks.
- To promote understanding and re-use of ideas developed in the project, by enabling easy access to project results.
- To drive high impact standardisation bodies (such as ETSI, IETF and 3GPP, among others) towards the adoption of UniverSelf's research approach and outcomes.
- To create momentum and favourable conditions for industry buy-in of the solutions developed by UniverSelf.

The D5.1 and D5.3 deliverables (not public), which have been released previously, aimed at detailing the project plans in terms of dissemination and exploitation. They covered the following trendsetting activities: presentation of the project in the web and in the public media, the scientific dissemination of the project results, their standardisation, the demonstration of project prototypes, trust and trendsetting activities, as well as the plans for the exploitation of the project results by academic and industrial partners.

Then, the present document is an update (second release) of the D5.2 deliverable and represents an outcome of the four tasks constituting work package 5 of UniverSelf. It reports all the trendsetting activities that have been actually achieved during the previous period (from September 2010 to October 2012). These activities are detailed in section 2 and span the following topics: publications, presentations, communication, project promotion, event organization (workshops, panels and special issues), demonstration activities, liaisons/collaboration with other projects and standardization actions.

This document will be updated by the end of the project to highlight all the trendsetting achievements and planned exploitation actions of UniverSelf results.

2 Trendsetting Activities

The trendsetting activities are divided into height categories that will be described in the following sections:

- Web-based presentations of the project and its activities (section 2.1),
- Dissemination of the project achievements through public documents (section 2.2),
- Presentation of the project and its results in the public media (section 2.3),
- Scientific dissemination by means of:
    - Publication of results in conferences and journals (section 2.4),
    - Co-organising or participating in relevant dissemination events (section 2.5),
    - Participating in events with support by the European Commission (section 2.6),
- Demonstration activities (demo booths) at widely-attended international events (section 2.7)
- Preparation and planning of open-source management solutions for future networks (section 2.8)
- Involvement in collaboration with other FP7 projects (section 2.9),
- Trust and trend setting activities (section 2.10),
- Involvement in standardisation activities and fora (section 2.11).

2.1 Web presence

Figure 1. Homepage of the UniverSelf public website (http://www.univerself-project.eu/).

UniverSelf operates an internal web site (groupware) that allows project partners to share results and to document the progress of the different work packages. In parallel to the internal web site, the project maintains the public website http://www.univerself-project.eu/ where third parties can access publicly released documents, such as technical reports, open source packages, and press releases, as well as get informed about the latest project news and achievements, workshop and event announcements, etc. It is indeed regularly used to publish news about the project and partners' activities and it provides the list of accepted publications. Besides, The UniverSelf website offers the possibility to subscribe to an RSS feed. A screenshot of the website homepage is provided in Figure 1.

In order to increase the visibility and web presence of the project, UniverSelf and its public website are now referenced on the following Wikipedia pages:

- Autonomic Networking: http://en.wikipedia.org/wiki/Autonomic_Networking
- In-Network Management: http://en.wikipedia.org/wiki/In-network_management
- Future Internet: http://en.wikipedia.org/wiki/Future_Internet

In addition, project partners manage the SimpleWeb website at http://www.simpleweb.org/. The website provides links and information on network management, including software, RFCs and tutorials.

2.2 Public documents

During the first and second project years, UniverSelf has released twelve public reports covering the main technical achievements of the project. These deliverables, listed in Table 1, are available on the public website of the project.

Table 1. List of UniverSelf public scientific deliverables that have been released (in chronological order)

Deliverable ID	Title	Delivery date
D4.1	Synthesis of use case requirements – Release 1	June 2011
D2.1	UMF Specifications – Release 1	July 2011
D3.1	Identification of suitable classes of methods for parameter optimization	September 2011
D3.3	Identification of suitable classes of methods for learning and operations	September 2011
D3.4	Cooperation strategies and incentives	December 2011
D4.2	Synthesis of use-case requirements – Release 2	April 2012
D3.7	Adaptation of learning and operation methods to specific needs of future networks and services	September 2012
D4.3	Assessment results of Trust in Autonomics – Release 1	September 2012
D4.5	Leaflet of the first prototype of a use-case	September 2012
D4.9	Leaflet of the second prototype of a use-case	September 2012
D2.2	UMF Specifications – Release 2	October 2012
D4.6	Synthesis of deployment results – Release 1	October 2012

Besides deliverables, UniverSelf partners have been working to produce milestone reports on work progress and white papers on relevant topics disseminating the project vision and achievements. Also, a white paper (or case study) per use case, organized in a series composed of 3 parts has been planned. The first part has been released for all use cases and the second one is under preparation. Then, the following white papers are currently available:

- Understanding the importance of context knowledge in network management,
- Use Case #1 - Self-diagnosis and self-healing for IMS VoIP and VPN - Case study Part 1

- Use Case #2 - Networks' Stability and Performance - Case study Part 1
- Use Case #3 - Dynamic Virtualization and Migration of Contents and Servers - Case study Part 1
- Use Case #4 - SON and SON Collaboration according to Operator Policies - Case study Part 1
- Use Case #6 - Operator-governed, end-to-end, autonomic, joint network and service management -Case study Part 1
- Use Case #7 - Network and Services Governance - Case study Part 1
- Controlling Network Stability and Performance (under preparation – not released yet).

2.3 Public communication

Besides traditional dissemination activities, additional communication channels and approaches, with potential high impact, are being used to promote the project achievement. During the first and second project years, the following materials have been prepared and disseminated:

- **First project leaflet:** a leaflet highlighting the project's objectives, approach and expected impact has been released and disseminated. It is used by UniverSelf partners in order to promote the project at the various events they have been attending. The leaflet is available on the project website at: http://www.univerself-project.eu/system/files/INFSO-ICT-257513_UniverSelf_DataSheet.pdf.
- **First Press release:** A first press release highlighting the project start and major challenges has been published by Alcatel-Lucent on its public website. This created a worldwide visibility for the project and several external parties British Telecom, China Telecom, NORDunet, MERA or else the TeleManagement Forum (TMF) have contacted the project partners in order to express their interest in future achievements. The press release has been relayed over more than 15 top technology and business news websites. The text of this press release is provided in Annex B.
- **Demo posters and leaflets:** UniverSelf participated with demo booths during the Future Internet week in Aalborg (May 2012) and the Future Network and Mobile Summit in Berlin (July 2012). At these occasions, project-global and demo-specific posters and leaflets have been prepared and distributed.

2.4 Scientific publications and presentations

The UniverSelf vision, approach and achievements, as well as technical results from project partners, have been disseminated by means of scientific publications. As depicted in Table 2, a large number of dissemination activities, including joint initiatives, have been undertaken.

Table 2. Scientific publications

Scientific Publications	Conferences	Book Chapters	Journals	Total
Published or Accepted for publication	66	3	14	83
Submitted under review	12	-	10	22
Total	**78**	**3**	**24**	**105**

The project objective is to be active and visible in all main workshops, conferences and journals on network management, as well as major events organized by the European commission, in order to ensure a high visibility for UniverSelf and its achievements. As an illustration of this, we highlight the following statistics:

- Seven papers (including regular, short and poster papers) and a tutorial from project partners have been presented at the 7th International Conference on Network and Service Management (http://www.cnsm2010.org/), which is a premier, highly selective conference in the general area of network and services management. Furthermore, the UniverSelf-related paper from France Telecom on "Self-organizing relays in LTE networks" has received the **best paper award**.
- Six papers (including regular and short papers) from project partners have been presented at the IEEE/IFIP International Network Operations and Management Symposium (http://www.ieee-noms.org/2012/), which is as well a premier, highly selective conference in the general area of network and services management. Furthermore, the UniverSelf-related paper from University of Surrey on "Optimization for Time-Driven Link sleeping Reconfigurations in ISP Backbone Networks" has received the **best student paper award**.
- Five papers from project partners have been presented at the 6th IFIP International Conference on Autonomous Infrastructure, Management and Security (http://www.aims-conference.org/2012/).
- Six papers – including four joint papers – from project partners covering UniverSelf activities (UMF specification and empowerment methods) have been presented at the Future Network and Mobile Summit 2012 (http://www.futurenetworksummit.eu/2012/). Besides, several workshop presentations have been provided by UniverSelf partners.
- Five papers – including three joint papers – from project partners covering UniverSelf activities (UMF Core mechanisms, empowerment methods and business scenarios) have been presented at the 17th IEEE International Workshop on Computer-Aided Modeling Analysis and Design of Communication Links and Networks (http://camad2012.av.it.pt). These papers are part of the UniverSelf special session.
- Finally (last but not least), among publications in international journals, three papers from project partners have been accepted for publication in the IEEE Transactions on Network and Service Management (http://www.comsoc.org/tnsm).

A comprehensive list of submitted and accepted papers, as well as performed presentations during the first project year, can be found in Annex A. This list, which is also available on the project public website, shows the variety and interdisciplinarity of targeted events. Besides, several of these publications are joint contributions from the project partners.

2.5 Organization of dissemination events

In order to increase the scientific visibility of UniverSelf, the project partners have been actively participating in the organisation of dissemination events, such as conferences and workshops, as well as special issues in high-impact journals.

Regarding the organization and co-organization of workshops and special sessions, the following activities have been achieved during the first and second project years:

- UniverSelf partners participated to the organization and contributed to the Federation Workshop, which took place in the context of Future Network and Mobile Summit 2011, 15-17 June 2011 in Warsaw, Poland. The Workshop was co-organized by UniverSelf, OneFIT and One projects; its purpose was to discuss the different approaches to federation that are being investigated in these ICT FP7 projects, focusing on how networks and their management can be federated using the approaches investigated in the three projects. Indeed, the workshop aimed to exploit complementarities between the approaches and to identify any potential gaps when looking at the whole network from access, core to backbone. The workshop initiated by UniverSelf has been a fair success and attracted more than 45 attendees during its four technical and panel sessions. The objectives and programme of this workshop can be found in Annex C.
- Then, as a follow-up, UniverSelf partners participated to the organization and contributed to the workshop on "Network Federation II". It was co-organized by UniverSelf, OneFIT, ONE and GEYSERS projects. The workshop aimed at the same topic as the previous one i.e. discuss the different approaches to federation that are being investigated in these ICT FP7 projects and hence to exploit complementarities. The objective was to sustain the interaction among the organizing projects and

share their latest achievement in this field. Again, the workshop attracted a good participation (similar to the previous edition). The objectives and programme of this workshop can be found in Annex D.

- TI, in the context of UniverSelf trendsetting activities, organized a workshop on the topic of "*Future Network Stability: Threats and Challenges*" which took place in the context of Future Network and Mobile Summit, July 2012 in Berlin, Germany. During the workshop, several partners (TIS, FT, UCL, NKUA and UPRC) presented their views and current technical activities related to this challenging research topic, which is part of the UniverSelf agenda. A more detailed report on this workshop can be found in Annex E.
- Members of UniverSelf have been involved in the organisation of a workshop on "*How disruptive technologies influence the FI ecosystem*", which was held in the context of the Future Internet Week, 24-28 October 2011 in Poznan, Poland. It was co-organized by the UniverSelf project, the SESERV support action and the FISE working group. The workshop aimed at a shared understanding of FI business ecosystem, the stakeholders and a comparison of approaches used to understand both baseline and future scenarios. More details about the workshop can be found at: http://fisa.future-internet.eu/index.php/%22FISE_Workshop:_How_Disruptive_Technologies_Influence_the_FI_Business_Ecosystem%22
- The UniverSelf project organized a special session on "*Modelling Tools, Network Empowerment Mechanisms & Testbeds for Future Service -& Operator- oriented Internet*" at the 17th IEEE CAMAD conference, which took place in Barcelona, Spain, 17-19 September 2012. The paper submission deadline was on June 8th, 2012. More details on the call for papers can be found at: http://camad2012.av.it.pt/ss_UniverSelf.html. Then, six papers have been accepted and presented during this special session. The detailed conference program is available at: http://camad2012.av.it.pt/program.html.
- Members of UniverSelf participated in the organization of the 2nd International Workshop on Self-Organizing Networks IWSON, which took place in Paris, France, 28 August 2012. The workshop was organized in the context of the Ninth International Symposium on Wireless Communication Systems, ISWCS 2012. The workshop covered the following topics: self-configuration, self-optimisation, self-healing, supporting SON functions and technologies, field trials and demonstrators in the context of self-organizing networks. More details on this workshop, including the complete program, can be found at: http://www.iswcs2012.org/workshop.
- Then, the third edition of the IWSON workshop will be also co-organized by UniverSelf members. The workshop will take place in the context of the IEEE VTC2013-Spring conference to be held in Dresden, Germany, June 2013. The paper submission deadline is scheduled on November 23rd, 2012. More details can be found at: http://tns.ds.unipi.gr/iwson2013/.
- UT organized the workshop on "*the usage of IPFIX/Netflow in network management*" in the context of IRTF-NMRG activities. The workshop took place in Paris, France, March 2012 (after the IETF 83 meeting).
- Besides, two workshops, proposed by UniverSelf partners, have been accepted and will be organized in the context of the IFIP/IEEE International Symposium on Integrated Network Management (IM 2013), to be held in Ghent, Belgium, May 2013. These two workshops address the following topics: "*Trust in Autonomics*" and "*Managing Stability and Orchestration in Future Software Empowered Networks*". Further details will be provided in the next reports on trendsetting.
- Finally, a first internal technical workshop (coordinated by INRIA) has been organized during the project plenary in February 2012 (Paris, France). The objective was to present ongoing activities related to the project topics, to share ideas and to enable technical discussions and further collaborations between partners. The workshop covered mainly topics in the context of WP3 (network empowerment methods and mechanisms). The complete program can be found in Annex F.

Regarding the organization of special issues in international journals, the following activities have been achieved during the first and second project years:

- Members of UniverSelf steered the guest editing of a special issue on “Managing an Autonomic Future Internet” in the IEEE Network Magazine. Indeed, this special issue covers the main research topics that

are addressed by the UniverSelf project. The magazine is expected to host papers from activities around the world. The special issue schedule is as follows: April 1st, 2011 (Full Paper Submissions), August 1st, 2011 (Author Notification about Acceptance) and September 1st, 2011 (Accepted papers in Final Form). More details on the special issue can be found at: http://dl.comsoc.org/livepubs/ni/info/cfp/cfpnetwork1111.htm. The special issue received 35 submissions out of which 6 have been accepted for publication in the IEEE Network Magazine special issue and 1 publication has been accepted and redirected for publication later labelled as an open call. The special issue preparation was also the occasion for the guest editors (Panagiotis Demestichas, Martin Vigoureux, Mikhail Smirnov, Antonio Manzalini, Sudhir Dixit) to draft the Guest Editorial on "Managing an Autonomic Future Internet" that will be published in the IEEE Network Magazine. This editorial references UniverSelf and acknowledges the special issue as an activity related to our project.

- Members of UniverSelf are organizing the Special Issue on “Managing Self-Organizing Radio Access Networks” in the Wiley International Journal of Network Management. The deadline for paper submissions is on November 1st, 2012; the acceptance notification is expected for March 1st 2013; and the special issue is expected to be published in July – August 2013. More details on the special issue can be found at: http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-1190. Again, this special issue will be the occasion for the guest editors (K. Tsagkaris, M. Gruber and B. Sayrac) to reference the UniverSelf project and its activities in the guest editorial.

Regarding the participation in the organization and committees of major international conferences on network management, the following activities have been achieved during the first and second project years:

- INRIA acted as general chair and co-organizer of the 5th International Conference on Autonomous Infrastructure, Management and Security (AIMS 2011). More information can be found at: http://www.aims-conference.org/2011/.
- Members of UniverSelf participated in the organization of the 7th International Conference on Network and Service Management (CNSM 2011) as General Chair (Prosper Chemouil, Orange Labs), Program Co-Chair (Olivier Festor, INRIA Nancy Grand Est), Finance Chair (Samir Ghamri-Doudane, Alcatel-Lucent Bell Labs), Webmaster (Olivier Festor, INRIA Nancy Grand Est), Steering Committee member (Aiko Pras, University of Twente), and members of the Technical Program Committee. More information can be found at: http://cnsm.loria.fr/.
- UT participated as technical program co-chair and steering committee member, with INRIA, in the organization of the 6th International Conference on Autonomous Infrastructure, Management and Security (AIMS 2012). More information can be found at: http://www.aims-conference.org/2012/.
- Besides, several members of UniverSelf participate in the Technical Program Committees of the IFIP/IEEE IM and IEEE/IFIP NOMS conferences, among others.

2.6 Participation to other events with support from the European Commission

UniverSelf has been actively participating in events and initiatives organized by the European Commission, such as: the Future Internet Assembly, Concertation and Cluster meetings, as well as EC promoted conferences. The project activities in this context Include:

- The participation (from TI, ALBLF and FT) in the organization and animation of a networking session at ICT 2010 (29 September 2010 in Brussels, Belgium) on the topic of "*Assessment of impacts of Autonomic and Cognitive Networking*". This networking session was prepared and submitted by TI.
- The participation of multiple UniverSelf partners to the EC D1 Concertation and Cluster meetings on 18-20 October 2010 in Brussels, Belgium. The objective was to present UniverSelf’s vision and planned activities, as well as to have a first contact with the projects belonging to the Future Internet cluster. The project was represented at this event by the coordinator (ALBLF). Follow-up liaisons and joint initiatives have been then triggered (as reported in this document).

- The organisation and chairing of the panel on "*Information and Execution Automation between the Service and Network planes*" at the Future Internet Cluster meetings on 09 February 2011 in Brussels, Belgium. Several ICT FP7 projects of the FI cluster participated to this panel and presented their perspectives on this issue, which allowed fruitful discussions on the aforementioned topic.
- The co-chairing of the Future Internet cluster. Martin Vigoureux (ALBLF) has been appointed at the February 2011 cluster meeting.
- The organisation and chairing of the panel on "*Cloud Management*" at the Future Internet Cluster meetings on 06 October 2011 in Brussels, Belgium. Several ICT FP7 projects of the FI cluster (ETICS, GEYSERS, OneFIT and ONE, among others) participated to this panel. The panel aimed at presenting, confronting and discussing the different perspectives on this important issue in the scope of the management of future networks. More details about the Cluster meeting and organized panel can be found at: http://ec.europa.eu/information_society/events/cf/fnc8/item-display.cfm?id=7109.
- The participation (from UCL) and contribution in the Net!works EU Technology Platform research activities and publications. A position paper on "*Networks of Future*" and a white paper on "*Future Networks and Management*" were produced and released in 2011. These documents are available at: http://www.networks-etp.eu/publications/sra-and-white-papers.html.
- The participation of multiple UniverSelf partners to the Future Internet week events (including the FIA) that have been held on: 13-17 December in Ghent, Belgium; and 16-19 May 2011 in Budapest, Hungary. Indeed, UniverSelf partners are particularly interested in and participating to the following FIA working groups: FIArch (Vision on the Future Internet Architecture), FISE (Future Internet Socio Economics) and the Standardization working group.
- The proposal of three sessions for the Future Internet Assembly that took place on 24-28 October 2011 in Poznan, Poland. After a voting process, the three sessions have been ranked in top five. Consequently, UniverSelf partners have been the main drivers and organizers of the following FIA sessions: (1) Value creation, value flows and liability over virtual resources; (2) Trustworthiness of services and infrastructure; and (3) Architectures. These sessions were also an opportunity for UniverSelf representatives to present the project approach and achievements related to the discussed topics (cf. the presentation list in Annex A). More details about these sessions can be found at: http://www.future-internet.eu/home/future-internet-assembly/poznan-october-2011.html. Besides, a workshop on "*How disruptive technologies influence the FI ecosystem*" has been co-organized by UniverSelf partners during this event (cf. section 2.5).
- The participation, with two keynotes (from UCL and INRIA), to the FIArch (Future Internet Reference Architecture Group) Workshop on 22 February 2012 in Brussels, Belgium. More details on this event and can be found at: http://ec.europa.eu/information_society/activities/foi/research/fiarch/index_en.htm.
- The active participation of the UniverSelf project to the Future Internet week (including the FIA) that has been held on May 2012 in Aalborg, Denmark. As part of this event, the UniverSelf Project participated to the standardisation brokerage event with a presentation on "*Standardization of a Unified Management Framework*". The following sessions have been targeted by UniverSelf partners as well: "*Open Platforms for Innovation*" and "*Interoperability between Clouds at Several Layers*". Besides, the project had a demo booth that attracted several visitors (cf. section 2.7).
- The involvement of UniverSelf members (ALBLF, UCL and NKUA) in the FIA steering committee.
- The publication and presentation of three papers (cf. Annex A), as well as the organization of the Federation Workshop (cf. Annex C), at the Future Network and Mobile Summit on 15-17 June 2011 in Warsaw, Poland.
- The publication and presentation of six papers – including four joint papers (cf. section 2.4 and Annex A), the organization of two workshops (cf. Annex D and Annex E), as well as a demo booth (cf. section 2.7) at the Future Network and Mobile Summit on 04-06 July 2012 in Berlin, Germany.

2.7 Demonstration activities

In addition to the usual trendsetting activities, demonstration of the project results and prototypes at widely-attended international events were given a special attention during the second year of the project. The objective was to showcase the main project achievements and capitalize on the released prototypes. The following lists the demonstration activities during the second project year:

- The UniverSelf project had a dedicated demo stand during the Future Internet week in Aalborg, Denmark, 7-11 May 2012. Posters and a leaflet have been prepared and made available for this occasion. The demo was on the theme of "*operator centric governance framework for end-to-end traffic deployment, resource optimization and dynamic network virtualisation*", and consisted of three subsequent parts: (1) "*Governance Framework for Network Optimisation & SON coordination*", (2) "*Governance and coordination of autonomic wireless access (LTE/SON-compliant) and core network (MPLS-based) segments*" and (3) "*Management of Software Driven Networks - Stability, Control, Orchestration and Migration of Nodes*".
- The UniverSelf had also a dedicated demo booth at the Future Network and Mobile Summit, which took place in Berlin, Germany, 4-6 July 2012. Again, the goal was to demonstrate UniverSelf use cases while highlighting the role and benefits of the UMF (in line with the FIA demo presented above). Also, dedicated posters and a leaflet have been prepared and made available for this occasion. Several scientists from various countries, projects and companies, including the European commission representatives, visited the UniverSelf booth and were highly interested by the demonstrated achievements. They had the opportunity to assess how the Unified Management Framework (UMF) allows the governance, cooperation and interoperability of network and service management systems and empowerment mechanisms. The main questions were around the standardization perspectives of the necessary UMF interfaces, as well as on the interfaces themselves.
- Besides, demonstrations on the topics of "fault diagnosis" and "anomaly detection" (in the scope of use case 1) have been presented by ALBLF during the Bell Labs Open Days in France on 23-25 May 2012. The Bell Labs Open Days are a good opportunity to showcase the project achievements to a wide audience: Industry representatives (operators and vendors), media and press representatives, as well as researchers.

2.8 Open source solutions for management of Future Networks

A set of integrated management platforms and supporting systems are being developed in the UniverSelf project. Some of such components and platforms are planned to be issued as open source solutions aiming to create a highly open and flexible environment for Management of Future Networks.

UniverSelf partners that plan to issue these open source solutions would commit to update, maintain and use these open source systems beyond the project period. The following is a short description of the open solutions under development, which are planned for release as open-source solutions as part of the UniverSelf activities. Of course, this is only a partial list of already identified software features; this list will be updated and augmented during the project course (according to future development plans).

Software Defined Networks & Services (SDNS) Platform - UCL

SDNS Platform, which is under development at UCL, represents an integration of computing with network virtualisation (e.g. an in-network cloud) and its functionality includes a Virtualization layer, which contains all of the virtualization technologies that abstract the elements in the hardware layer and provide the necessary management and orchestration functions needed to build and deploy services. It also includes a Service layer, which supports and contains the services themselves. The services use the various service APIs in order to access the elements in the virtualization layer In the SDNS Platform the Virtual Routers, Virtual Links and Service Components are Java based Virtual Machines. The following systems are planned for development:

- Monitoring of service components and keeping the dynamic links between them up-to-date.
- Knowledge and Context service distributed platform for collecting, storing and distributing context & knowledge information to clients.

- Virtualisation of networking and computational resources and linking virtual resources with real resources.
- Service enablers and self - functionality (self-monitoring, self-configuration, self-optimisation and self-adaptation).
- Control & Orchestration capabilities for managing the composition and decomposition of multiple domains.
- Programmability of the Virtualisation environment.

Integrated Vulnerability Management - INRIA

Providing a fully automated chain to manage vulnerabilities is essential to build the self-protection dimension of the future Internet. We will provide the missing pieces in the well-established cfengine configuration framework (http://www.cfengine.org) to support this self-management feature. The following components are planned for development:

- A full-fledged OVAL (Open Vulnerability Assessment Language) specifications framework; the objective is to enable the autonomic system to extract the knowledge provided by vulnerability descriptions specified with this language (http://oval.mitre.org).
- A translation engine generating cfengine policies from OVAL specifications; these policies will then be interpreted by the configuration framework in order to prevent vulnerabilities and maintain safe configurations (as part of the work done in particular in Use Case 2).

2.9 Collaboration and liaisons with other EU-funded projects and beyond

UniverSelf is pursuing collaborations and liaison activities with current national and European projects (ICT FP7 and Eureka/Celtic frameworks), as well as research initiatives and fora at European and international level. A dedicated liaison process has already been defined and put in place within the project in order to facilitate exchange and synergies with other EU-funded projects. Moreover, a dedicated UniverSelf member is appointed (or will be) as contact person for each liaison with the aim to ensure efficient collaborations. A specific document (relative to milestone MS45), entitled "Review of project liaisons: initial links with Future Internet international projects", has been issued; it details the global objectives as well as the initial list of investigated liaisons (project descriptions, topics of common interest, means of interactions and appointed contacts). This list is continuously updated, and it currently includes the following projects and initiatives:

- SAIL (ICT FP7 project): Scalable and Adaptive Internet Solutions.
- ONEFIT (ICT FP7 project): Opportunistic networks and Cognitive Management Systems for Efficient Application Provision in the Future Internet.
- ONE (ICT FP7 project): Towards Automated Interactions between the Internet and the Carrier-Grade Management Ecosystems.
- ETICS (ICT FP7 project): Economics and Technologies for Inter-Carrier Services.
- CONSERN (ICT FP7 project): COoperative aNd Self growing Energy awaRe Networks.
- SESERV (coordination and support action): Socio-Economic Services for European Research Projects.
- GEYSERS (ICT FP7 project): Generalised Architecture for Dynamic Infrastructure Services.
- NESSoS (ICT FP7 project): Network of Excellence on Engineering Secure Future Internet Software Services and Systems.
- COMMUNE (Celtic Project): Cognitive network Management under Uncertainty.
- ETSI AFI (ISG - Industry Specification Group): Autonomic network engineering for the self-managing Future Internet.
- ITU-T FG FN (Pre-standardization group): Focus Group on Future Networks; and ITU-T SG13.
- TMF (Industry association): TeleManagement Forum.

These liaisons have been implemented through regular interactions, technical discussions, face-to-face meetings (at the Future Internet Weeks, as well as concentration and cluster meetings) and the organization of joint dissemination events. As concrete examples of such joint events, UniverSelf has:

- Chaired two panels, at the February 2011 cluster meeting and the October 2011 cluster meeting, with the participation of several ICT projects (cf. section 2.6),
- Co-organized the Federation Workshop in June 2011 together with OneFIT and ONE projects, as well as the second edition of this workshop in July 2012 together with OneFIT, ONE and GEYSERS projects (cf. section 2.5, Annex C and Annex D);
- Co-organized a workshop on "How disruptive technologies influence the FI ecosystem" together with the SESERV support action and the FISE working group (cf. section 2.5);
- Proposed and co-organized three technical sessions in the context of the Future Internet Assembly 2011 in Poznan. Several ICT projects and research initiatives participated to these sessions (cf. section 2.6 and FIA Poznan Program).
- Organized the first technical meeting on "trust in autonomics" as part of the ETSI AFI meeting in September 2011 (cf. section 2.10), and invited the ETSI AFI for an opening presentation at the second edition of the Federation workshop (cf. Annex D).

Besides these events, VTT (UniverSelf partner) has co-organized the First International Workshop on Energy-Efficient Data Centres (E2DC 2012) as a part of cooperative activities in the Future internet topics in collaboration with the Fit4Green project (ICT FP7 project on energy aware ICT optimization policies).

Moreover, UniverSelf partners have assessed the feasibility and relevance of using National and European experimental facilities, within the FIRE – Future Internet Research and Experimentation – Initiative, in order to experiment and validate the emerging UniverSelf technologies at large scale. A dedicated milestone has been achieved (MS37) and a dedicated report on "predisposition of access to external test-bed(s) facilities" has been released.

2.10 Trust and certification trendsetting activities

One of the main trendsetting objectives of UniverSelf is to establish and develop the trust from all stakeholders of the autonomic networking ecosystem. A concrete plan towards this objective has been established at the start of the project and is continuously assessed and adapted to emerging opportunities. Moreover, the ETSI agreed to closely cooperate with the UniverSelf consortium and provide a significant help (logistics, contacts and expertise) in preparing and organizing dedicated events. During the first and second project years, UniverSelf partners have started implementing this plan through:

- A presentation, jointly prepared by UniverSelf partners, at the ETSI workshop on Future Networks technologies, which was held in Sophia-Antipolis, France, September 2011. The presentation is entitled "*Unified approach to Trust in Autonomic Networks and their Management*" and focuses on highlighting the standardization needs and opportunities related to this topic, while promoting the UniverSelf approach and findings.
- The organization, by UniverSelf partners, of the first technical meeting on "*trust in autonomics*" as part of the ETSI AFI meeting in Sophia-Antipolis, France, September 2011. The UniverSelf approach has been presented during the meeting. The ensuing discussions have highlighted significant interest among participants. Therefore, as a follow-up action, we are considering the opportunity to add this topic to the ETSI AFI agenda and align our standardization plan.
- The co-organization of a dedicated session, by UniverSelf partners, at the Future Internet Assembly (FIA) held in Poznan, Poland, October 2011. This session is entitled "*Trustworthiness of services and infrastructure*". It also covers the standard perspective (in line with FIA Standardization activities) and discussions on how to subscribe trust, certification, labelling and testing to standardization bodies' agenda such as ETSI or TM Forum. Again, the UniverSelf approach has been included as part of the discussion.
- The preparation of a questionnaire and list of experts in collaboration with task 4.4 (conducting technical work on trust and certification). Indeed, Project partners identified 13 key questions around trust in autonomics with which they are approaching a dozen of distinguished international experts in

trust engineering and four ETSI cross-disciplinary groups dealing with the issues of trust in aeronautics, intelligent transport systems, testing methods and interoperability.

- The publication of a joint paper, from UniverSelf partners, entitled "*Unifying Management of Future Networks with Trust*" in the Bell Labs Technical Journal (BLTJ) special issue on "*Delivering Network Assurance*" (Vol. 17, No. 3, December 2012). The paper presents important technical achievements of task 4.4 on trust in autonomics.

2.11 Standardization and pre-standardization

During the first phase of the project, a survey of potential standardization bodies, working groups and initiatives relevant for the project has been achieved by the project partners and provided as a first draft of the standardization plan (and reported in the D5.1 deliverable). Then, the next step consisted in refining this plan with the aim to identify a restricted set of standardization groups, to be targeted in priority, and to establish an action plan taking into account the planned project achievements and their timing. The completion of this second step corresponded to a project milestone (MS48) and the resulting refined plan has been reported in the D5.3 deliverable.

This refined plan presents the main identified standardization groups to be targeted, which are: ETSI AFI, the TM Forum, ITU-T SG13 and IRTF relevant working groups. The choice of these standardization groups is based on three criteria: the relevance with UniverSelf activities and plans; Partners' expertise and participation within these groups; and their impact. Then, it also presents some other standardisation groups that may be of interest, in relation with partners' current activities, namely: 3GPP and NGMN.

The plan will be further adapted and refined in the next period of the project in synchronisation with the planned UniverSelf main achievements, such as: UMF releases, trust and certification approaches, and coordination mechanisms, among other activities. Indeed, UniverSelf partners periodically assess the status of the project outcomes and amend the standardization plan accordingly. The outcome of this analysis has been publicly presented at different points in the project lifetime and at various venues; we can cite as examples:

- Two presentations at the ETSI workshop on Future Networks technologies, which was held in Sophia-Antipolis, France, September 2011. The first presentation is entitled "*Unified Management Framework: Processes and Tools for Establishing Autonomics in the Management of Networks and Services*" and focuses on presenting the status of the UMF design (at that point in time) and highlighting the related standardization needs and opportunities. The second presentation is entitled "*Unified approach to Trust in Autonomic Networks and their Management*" and focuses on highlighting the standardization needs and opportunities related to this topic, while promoting the UniverSelf approach and findings. Details can be found at: http://www.etsi.org/WebSite/NewsandEvents/FNT/FutureNetworkTechnologies.aspx.
- An accepted paper and presentation at the "Telecommunications: from Research to Standards" workshop co-located with the IEEE ICC 2012 conference. The paper provides a good overview of the "UMF release 2" ongoing specification work (at that point in time) and discusses the standardization needs and potential plan in this context. The paper is entitled: "*Identifying standardization opportunities of an operator-driven framework for unifying autonomic network and service management*".

In the meanwhile, UniverSelf partners have started implementing the standardization plan. During the first and second years of the project, five standards influenced by the UniverSelf project, where UniverSelf is referenced explicitly, have been released officially:

- **ITU-T Y.3001 Recommendation** (May 2011) – "*Future Networks: Objectives and Design Goals*". This Recommendation describes objectives and design goals for Future Networks (FNs). In order to differentiate FNs from existing networks, four objectives were identified, which are service-, data-, environment-, and social and economic awareness. In order to realize the objectives, twelve design goals were identified, which are service diversity, functional flexibility, virtualization of resources, data access, energy consumption, service universalization, economic incentives, network management, mobility, optimization, identification, reliability and security. This Recommendation assumes that the target timeframe for FNs fall approximately between 2015 and 2020. In the appendix, this Recommendation describes technologies elaborated in recent research efforts that are likely to be used as an enabling technology of each design goal. It is downloadable at: http://www.itu.int/rec/T-REC-Y.3001-201105-I.

- **ITU-T Y.3011 Recommendation** (January 2012) – "*New Framework of network virtualization for Future Networks*". This Recommendation describes the framework of network virtualization for Future Networks (FNs). It presents its definition, effectiveness, and its provisioning, logically isolated network partition. This Recommendation also discusses the problem spaces of network virtualization in the networks and investigates its several design goals. Finally, applicability of network virtualization is discussed. In appendix, detailed use-cases on various aspects such as experimental network and mobility are presented. It is downloadable at: http://www.itu.int/rec/T-REC-Y.3011-201201-I.
- **ITU-T Y.3021 Recommendation** (January 2012) – "*New Framework of energy saving for Future Networks*". This recommendation describes the framework of energy saving for Future Networks (FNs). It first presents the need for energy saving of networks themselves, and reviews potential technologies. The document then identifies major functions and their cyclic interactions, analyses possible impacts of introducing the technologies, and itemises the high-level requirements for introducing the technologies. It is downloadable at: http://www.itu.int/rec/T-REC-Y.3021-201201-I.
- **ETSI AFI-001 Group Specification** (June 2011) – "*Scenarios, Use Cases, and Requirements for Autonomic/Self-Managing Future Internet* ". Scenarios and use cases selected and presented in this document reflect real-world problems which can benefit from the application of autonomic principles. It is downloadable at: http://webapp.etsi.org/action%5CPU/20110705/gs_AFI001v010101p.pdf.
- **ETSI AFI-002 Group Specification** (November 2012) – "*Generic Autonomic Network Architecture (An Architectural Reference Model for Autonomic Networking, Cognitive Networking and Self-Management)*". The released document will be made public on the ETSI portal soon.

Then, as part of the IETF/IRTF activities, UniverSelf partners are currently in the process of commenting on and contributing to the active Internet-Draft entitled "*A Framework for Autonomic Networking*" (available at: http://tools.ietf.org/html/draft-behringer-autonomic-network-framework-00). Also, they have actively participated (with presentations as well) in the LCCN and NMRG meetings during the previous period; and UT (UniverSelf partner) organized the workshop on "*the usage of IPFIX/Netflow in network management*" in the context of IRTF-NMRG activities.

Besides this, during the first project year, partners participated in several standardization meetings, with the aim to monitor the current activities, present topics related to current UniverSelf activities and assess opportunities for future contributions based on the project output and agreed plan. These meetings are:

- ETSI AFI meeting on 3-4 November 2010 in Budapest,
- IETF (and IRTF) meeting on 7-12 November 2010 in Beijing,
- ITU FG-FN meeting on 29 November – 3 December 2010 in Ljubljana,
- ETSI AFI meeting on 16-18 March 2011 in Sophia-Antipolis,
- IETF (and IRTF) meeting on 27-31 March 2011 in Prague,
- Standardisation session II.4 at the FIA conference on 17-19 May 2011 in Budapest, Hungary. The event report is available at: http://www.future-internet.eu/fileadmin/documents/budapest_documents/FIA-Budapest_Consolidated_final_300611.pdf,
- IETF (and IRTF) meeting on 24-29 July 2011 in Quebec,
- IETF (and IRTF) meeting on 13-18 November 2011 in Taipei,
- ETSI AFI meeting on 26-27 March 2012 in Sophia-Antipolis,
- IETF (and IRTF) meeting on 25-30 March 2012 in Paris,
- The standards brokerage event at the FIA conference on 10-11 May 2012 in Aalborg, Denmark. A presentation on "*Standardization of a Unified Management Framework*" has been provided. The program and presentation slides are available at: http://www.fi-aalborg.eu/index.php/program/session-2-4-standardisation,
- ETSI E2NA meeting on 15-16 May 2012 in Sophia-Antipolis,

- IETF (and IRTF) meeting on 29 July - 03 August 2012 in Vancouver,
- ETSI E2NA meeting on 10-14 September 2012 in Sophia-Antipolis,
- ETSI AFI meeting on 13-14 September 2012 in Sophia-Antipolis,
- As well as, all ETSI AFI virtual meetings during the previous period.

3 Conclusion

The UniverSelf consortium has been very active in terms of trendsetting activities during the first and second years of the project. This report details the activities achieved in this context, which covers: the project web presence, the public release of project promotion publications as well as technical documents, a significant number of scientific publications in main conferences and journals on network management, the organization of several dissemination events, The demonstration of UniverSelf first prototypes at widely-attended events, the collaboration with international research initiatives, the initial steps towards standardization, among other achievements.

As a self-assessment, we can report that the project has delivered significant results in all areas of the work package 5, reaching (and in some areas exceeding) its objectives. The project has delivered a sustained and successful promotion of the project activity and achievements so far.

The main trendsetting achievements in year 1 and year 2 of UniverSelf are:

- A total of 105 scientific publications: 83 published or accepted for publication, 22 submitted for review.
- Public release of 12 major technical reports, 8 white papers and 2 general project promotion publications: the project leaflet and a first press release; in addition to project and demo posters.
- Set-up and maintenance of an active web presence, which is referenced by Wikipedia.
- Release of five of the first standards with contribution and influence from the UniverSelf project: Y.3001 recommendation approved in May 2011 by ITU-T, Y.3011 recommendation approved in January 2012 by ITU-T, Y.3021 recommendation approved in January 2012 by ITU-T, AFI-001 group specification approved in May 2011 by ETSI and AFI-002 group specification approved in October 2012 by ETSI.
- Planning, monitoring of and participation in standardisation or pre-standardisation group meetings.
- Demonstration of the first UMF-compliant prototypes and network empowerment mechanisms at 3 widely-attended events.
- Organisation of relevant dissemination events and activities: workshops and special sessions (7); special issues (2); and active participation in events with European Commission support.
- Collaboration with other EU-funded projects and international research initiatives (12).
- Preparation and planning of open-source solutions for management of future networks: 2 platforms under development at UCL and INRIA.

The objective for the final period is to sustain the project efforts in promoting the project vision and results, especially by:

- Strengthening the web-presence of the project and public releasing of technical documents (planned deliverables as well as relevant white papers).
- Preparing and distributing technical newsletters, as well as further press releases, in order to promote the project technical achievements.
- Maintaining the consortium efforts in delivering high quality scientific publications (including joint papers among partners) and organizing impactful dissemination events.
- Encouraging and supporting publications on the main project objectives and outcome, such as the Unified Management Framework, the Network Empowerment mechanisms, the technology of trust and certification.
- Promoting the major project achievements and innovation through participation in exhibition, demonstration and interoperability events with premium proof-of-concept prototypes (especially integrated prototypes) using the UniverSelf technology.
- Sustaining the collaboration with research initiatives at European and international level, and investigating liaisons with newly-launched projects.

- Strengthening, pursuing the refinement, as well as the implementation, of the project standardization plan, which will be continuously assessed and adapted to emerging opportunities.
- Realization of the exploitation plans by academic and industrial partners.

Of course, this is a non-exhaustive list of tools and targeted activities. The document will be updated by the end of the project to highlight all the trendsetting achievements and planned exploitation actions of UniverSelf results.

Abbreviations

3GPP	3rd Generation Partnership Project
AFI	Autonomic network engineering for the self-managing Future Internet
ETSI	European Telecommunications Standards Institute
FG-FN	Focus Group – Future Networks
FIA	Future Internet Assembly
ICT	Information and Communication Technologies
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IRTF	Internet Research Task Force
ISG	Industry Specification Group
ITU-T	International Telecommunication Union – Telecommunications standardisation sector
LCCN	Learning Capable Communication Networks
LTE	Long Term Evolution
NGMN	Next Generation Mobile Networks
NMRG	Network Management Research Group
OVAL	Open Vulnerability Assessment Language
SDNS	Software Defined Networks and Services Platform
SG 13	Study Group 13
SON	Self Organized Networks
TM Forum	TeleManagement Forum
UMF	Unified Management Framework

Annex A – Scientific publications and presentations

The following sections give a complete list of the scientific publications and presentations realized by project partners in the context of the UniverSelf project.

Published and accepted papers

Journals:

- S. Georgoulas and K. Moessner: “Towards Efficient Protocol Design through Protocol Profiling and Performance Assessment: Using Formal Verification in a Different Context”, accepted for publication in the Wiley International Journal of Communication Systems.
- N. Wang, C. Michael and K. Hon Ho: "Disruption-Free Green Traffic Engineering with Not-Via Fast Reroute", accepted for publication in the IEEE Communications Letters.
- K. Tsagkaris, M. Akezidou, A. Galani and P. Demestichas: “Evaluation of signalling loads in cognitive network management architecture”, accepted for publication in the International Journal of Network Management.
- K. Tsagkaris, G. Athanasiou, M. Logothetis, Y. Kritikou, D. Karvounas and P. Demestichas: “Introducing Energy Awareness in the Cognitive Management of Future Networks”, accepted for publication in the Journal of Green Engineering (as invited paper).
- M. Wódczak, T.B. Meriem, R. Chaparadza, K. Quinn, B. Lee, L. Ciavaglia, K. Tsagkaris, S. Szott, A. Zafeiropoulos, B. Radier, J. Kielthy, A. Liakopoulos, A. Kousaridas and M. Duault: “Standardising a Reference Model and Autonomic Network Architectures for the Self-managing Future Internet”, accepted for publication in the IEEE Network Magazine Special Issue on Managing an Autonomic Future Internet.
- T. Sutinen, H. Rivas and J. Huusko: "Multi-Interface extension to scalable video streaming architecture", accepted for publication in the Journal of Communications special issue on advances in communications and networking.
- V. Foteinos, K. Tsagkaris, P. Peloso, L. Ciavaglia and P. Demestichas: "Energy Savings with Multilayer Traffic Engineering in Future Core Networks", accepted for publication in the Journal of Green Engineering.
- K.Tsagkaris, A.Bantouna and P.Demestichas, "Self-Organizing Maps for Advanced Learning in Cognitive Radio Systems", accepted for publication in the Elsevier Computers and Electrical Engineering.
- G. Athanasiou, K. Tsagkaris, P. Vlacheas, D. Karvounas and P. Demestichas "Multi-Objective Traffic Engineering for Future Networks", accepted for publication in the IEEE Communications Letters.
- R. Combes, Z. Altman and E. Altman: "Self-Organizing Relays: Dimensioning, Self-Optimization and Learning", accepted for publication in the IEEE Transactions on Network and Service Management.
- F. Francois, N. Wang, K. Moessner and S. Georgoulas: "Optimising Link Sleeping Reconfigurations in ISP Networks with Off-peak Time Failure Protection", accepted for publication in the IEEE Transactions on Network and Service Management.
- A. Sperotto and M. Mandjes, R. Sadre, P. T. de Boer and A. Pras: "Autonomic Parameter Tuning of Anomaly-Based IDSs: an SSH Case Study", accepted for publication in the IEEE Transactions on Network and Service Management.
- R. Clegg, S. Clayman, G. Pavlou, L. Mamatas, and A. Galis: "On the Selection of management and monitoring nodes in dynamic networks", accepted for publication in the IEEE Transactions on Computers.
- L. Ciavaglia, S. Ghamri-Doudane, M. Smirnov, P. Demestichas, V. Stavroulaki, A. Bantouna, B. Sayrac: "Unifying Management of Future Networks with Trust", accepted for publication in the Bell labs Technical Journal Special Issue on Delivering Network Assurance through Secure and Reliable Products, Software, Services and Solutions.

Conferences and Workshops:

- H. Eckhardt, S. Klein, and M. Gruber: “Vertical antenna tilt optimization for LTE base stations“, In proceedings of the International Workshop on Self-Organizing Network at IEEE VTC Spring 2011, May 2011, Budapest, Hungary.
- N. Wang, A. Fagear and G. Pavlou: “Adaptive Post-failure Load Balancing in Fast Reroute Enabled IP Networks”, In proceedings of the IFIP/IEEE International Symposium on Integrated Network Management (IM 2011), May 2011, Dublin, Ireland.
- A. Sperotto and A. Pras: "Flow-based Intrusion detection", In proceedings of the IFIP/IEEE International Symposium on Integrated Network Management (IM 2011), May 2011, Dublin, Ireland.
- T. Fioreze and A. Pras: “Self-Management of Hybrid Optical and Packet Switching Networks”, In proceedings of the IFIP/IEEE International Symposium on Integrated Network Management (IM 2011), May 2011, Dublin, Ireland.
- P. Demestichas, K. Tsagkaris, G. Athanasiou and Y. Kritikou: “Green Footprint of Cognitive Management Technologies for Future Networks”, In proceedings of the Workshop on ECO-Efficient ICT at the 34th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO 2011), May 2011, Opatjia, Croatia.
- T. Taleb, K. Samdanis, and S. Schmid: "DNS-based Solution for Operator Control of Selected IP Traffic Offload", In proceedings of the IEEE International Conference on Communications (ICC 2011), June 2011, Kyoto, Japan.
- M. Gruber, S. Borst and E. Kühn: “Stable interaction of self-optimization processes in wireless networks”, In proceedings of the Workshop on Planning and Optimization of Wireless Communication Networks at IEEE ICC 2011, June 2011, Kyoto, Japan.
- R. Combes, Z. Altman, M. Haddad and E. Altman: "Self-optimizing strategies for interference coordination in OFDMA networks", In proceedings of the Workshop on Planning and Optimization of Wireless Communication Networks at IEEE ICC 2011, June 2011, Kyoto, Japan.
- L. Ciavaglia, C. Destré, G. Nguengang, P. Demestichas, M. Gruber, M. Smirnov, A. Manzalini, N. Alonistioti, S. Ghamri-Doudane, A. Galis: “Realizing Autonomics for Future Networks”, In proceedings of the Future Network and Mobile Summit, June 2011, Warsaw, Poland.
- V. Gonçalves, L. Ciavaglia, S. Delaere and P. Ballon: “A Survey of the Future Internet Business Ecosystems”, In proceedings of the Future Network and Mobile Summit, June 2011, Warsaw, Poland.
- S. Georgoulas, M. Ghader, K. Moessner, M. Dianati and R. Tafazolli: “On the Applicability of Architecture Description Languages to Future Internet Networking Environments”, In proceedings of the Future Network and Mobile Summit, June 2011, Warsaw, Poland.
- M. Barrere, R. Badonnel, and O. Festor: “Toward Vulnerability Management in Autonomic Networks and Services”, In Proceedings of the IFIP International Conference on Autonomous Infrastructure, Management and Security (AIMS 2011) – PhD Symposium, June 2011, Nancy, France.
- R. Schmidt, A. Pras: “Estimating bandwidth requirements using flow-level measurements”, In Proceedings of the IFIP International Conference on Autonomous Infrastructure, Management and Security (AIMS 2011), June 2011, Nancy, France.
- X. Gelabert, B. Sayrac and S. Ben Jemaa: “a performance evaluation framework for control loop interaction in self organizing networks”, In Proceedings of the 22nd annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2011), September 2011, Toronto, Canada.
- L. Ciavaglia, Z. Altman, E. Patouni, A. Kaloxylos, N. Alonistioti, K. Tsagkaris, P. Vlacheas and P. Demestichas: “Coordination of Self-Organizing Network Mechanisms: Framework and Enablers”, In proceedings of the Special Session on Future Research Directions at ICST MONAMI 2011 conference, September 2011, Aveiro, Portugal.
- R. Hofstede, I. Drago, A. Sperotto and A. Pras: “Flow Monitoring Experiences at the Ethernet-Layer”, In proceedings of the 17th EUNICE 2011 Workshop on "Energy-Aware Communications", September 2011, Dresden, Germany.

- R. Combes Z. Altman, E. Altman: “Self-organizing relays in LTE networks: queuing analysis and algorithms” (**Best paper award**), In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011), October 2011, Paris, France.
- M. Barrere, R. Badonnel, and O. Festor: “Supporting Vulnerability Prevention in Autonomic Networks using OVAL”, In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011), October 2011, Paris, France.
- D. Tuncer, M. Charalambides, G. Pavlou and N. Wang: "Coordinated, Decentralized and Adaptive Network Resource Management", In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011) – Mini-conference track, October 2011, Paris, France.
- S. Clayman, R. Clegg, L. Mamatas, G. Pavlou and A. Galis: "Monitoring, Aggregation and Filtering for Efficient Management of Virtual Networks", In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011) – Mini-conference track, October 2011, Paris, France.
- V. Ayyadurai, K. Moessner and R. Tafazolli: “Multihop Cellular Network Optimization using Genetic Algorithms”, In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011) – Poster Sessions, October 2011, Paris, France.
- P. Vlacheas, V. Thomatos, K. Tsagkaris and P. Demestichas: “Autonomic Downlink Inter-Cell Interference Coordination in LTE Self-Organizing Networks", In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011) – Poster Sessions, October 2011, Paris, France.
- G. Athanasiou, K. Tsagkaris, P. Vlacheas and P. Demestichas: “Introducing Energy-Awareness in Traffic Engineering for Future Networks", In Proceedings of the 7th International Conference on Network and Service Management (CNSM 2011) – Poster Sessions, October 2011, Paris, France.
- V. Gonçalves, M. Stamatelatos, A. Manzalini, B. Fuentes, M. Gruber, C. Destré, S. Delaere, and L. Ciavaglia: “Construction, instantiation and analysis of a business ecosystem for autonomic future networks”, In proceedings of the ICIN 2011 Conference, October 2011, Berlin, Germany.
- C. Wang, N. Wang, M. Howarth and G. Pavlou: “An Empirical Study on the Interactions between ALTO-assisted P2P Overlays and ISP Networks”, In proceedings of the Workshop on Wireless and Internet Services (WISE) at the IEEE Conference on Local Computer Networks (LCN 2011), October 2011, Bonn, Germany.
- H. A. Hakim, H. Eckhardt, and S. Valentin: "Decoupling antenna height and tilt adaptation in large cellular networks", In proceeding of the Eighth International Symposium on Wireless Communication Systems (ISWCS 2011), November 2011, Aachen, Germany.
- D. Kliazovich, T. Sutinen, H. Kokkoniemi-Tarkkanen, J. Mäkelä, and S. Horsmanheimo: "Hierarchical Management Architecture for Multi-Access Networks", In proceedings of the IEEE Global Communications Conference (GLOBECOM 2011), December 2011, Houston, USA.
- K. Tsagkaris, P. Vlacheas, A. Bantouna, P. Demestichas, G. Nguengang, M. Bouet, L. Ciavaglia, P. Peloso, I. Grida Ben Yahia and C. Destré: "Operator-driven Framework for Establishing and Unifying Autonomic Network and Service Management Solutions", In Proceedings of the 3rd IEEE International Workshop on Management of Emerging Networks and Services (MENS 2011) at the IEEE Global Communications Conference (GLOBECOM 2011), December 2011, Houston, USA.
- S. Clayman, and A. Galis: "INOX: A Managed Service Platform for Inter-Connected Smart Objects", In proceedings of the workshop on Internet of Things and Service Platforms (IoTSP 2011) at the ACM CoNEXT 2011 Conference, December 2011, Tokyo, Japan.
- M. Liinasuo, I. Aaltonen, H. Karvonen, B. Fuentes and A. Castro: "Human Operator Perspective in Autonomic Network Management", In proceedings of The Fifth International Conference on Advances in Computer-Human Interactions (ACHI 2012), January 2012, Valencia, Spain.
- R. Combes Z. Altman and E. Altman: "Self-organization in wireless network: a flow-level perspective", In proceedings of the 31st IEEE International Conference on Computer Communications (INFOCOM 2012), March 2012, Orlando, USA.
- S. Klein: "Assessment of downlink signaling performance for intra-LTE intra-frequency mobility load balancing", In proceedings of the IEEE Wireless Communications and Networking Conference (WCNC 2012), April 2012, Paris, France.

- F. Francois, N. Wang, K. Moessner and S. Georgoulas: "Optimization for Time-Driven Link sleeping Reconfigurations in ISP Backbone Networks" (**Best student paper award**), In proceedings of the IEEE/IFIP International Network Operations and Management Symposium (NOMS 2012), April 2012, Maui, USA.
- D. Tuncer, M. Charalambides, G. Pavlou and N. Wang: "DaCoRM : A Coordinated, Decentralized and Adaptive Network Resource Management Scheme", In proceedings of the IEEE/IFIP International Network Operations and Management Symposium (NOMS 2012), April 2012, Maui, USA.
- L. Bennacer, L. Ciavaglia, A. Chibani, Y. Amirat and A. Mellouk: “Optimization of fault diagnosis based on the combination of Bayesian Networks and Case-Based Reasoning”, In proceedings of the IEEE/IFIP International Network Operations and Management Symposium (NOMS 2012) – Poster Sessions, April 2012, Hawaii, USA.
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- A. Manzalini (session chair), Christian Destré and Laurent Ciavaglia: participation and presentations during the networking session at ICT 2010 on the topic of “Assessment of impacts of Autonomic and Cognitive Networking”, September 2010, Brussels, Belgium.
- L. Ciavaglia: presentation of UniverSelf at the concertation meeting and the Future Internet Cluster meeting, October 2010, Brussels, Belgium.
- A. Galis: Presentation of UniverSelf at the ITU-T workshop, December 2010, Ljubljana, Slovenia.
- A. Galis: Keynote presentation on “Future Networks” at the IEEE ITU-T Kaleidoscope “Beyond the Internet”, December 2010, Pune, India.
- A. Pras: “Learning from the past - why OSI failed”, presentation at the Dagstuhl seminar "Learning from the Past: Implications for the Future Internet and Its Management?”, January 2011, Leibniz, Germany.
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- L. Ciavaglia: “Role and Impact of Autonomics in a Federated Eco-system”, at the Federation workshop – part of the Future Networks and Mobile Summit, June 2011, Warsaw, Poland.
- G. Nguengang: “A Unified Management Framework for Operator-Governed Networks and Services”, at the Federation workshop – part of the Future Networks and Mobile Summit, June 2011, Warsaw, Poland.
- A. Manzalini: chair of the panel “Network Federation - Way Forward” at the Federation workshop – part of the Future Networks and Mobile Summit, June 2011, Warsaw, Poland.
- S. Schmid: “NLE Vision for Beyond 4G (B4G) Mobile Networks”, presentation at NEC-internal workshop, 2011.
- S. Schmid, J. Lessmann, Z. Yousaf: “Motivation and Business Relevance of EU UniverSelf Project”, presentation at NEC-internal workshop, 2011.
- P. Demestichas, K. Tsagkaris, P. Vlacheas, G. Nguengang, M. Bouet, I. G. Ben Yahia, C. Destré, S. Ghamri-Doudane and L. Ciavaglia: "Unified Management Framework: Processes and tools for establishing autonomics in the management of networks and services", presentation at the 2nd ETSI Workshop on

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- Mikhail Smirnov: UniverSelf achievements as MS28 and partially the work of WP3 taskforce on SON interactions were integrated into the two lecture courses at TU Berlin “Advanced Internet Services” (WS2010/2011), and “Future Internet Technologies” (SS2011).
- Mikhail Smirnov: Two UniverSelf presentations for the Technical Board of NGNI in Fraunhofer FOKUS.
- A. Galis: "Management in the context of 3 types of Cloud Infrastructures", presentation at the FI consertation meeting, October 2011, Brussels, Belgium.
- A. Galis: "Future Internet Architectural Topics and Systems Overview", presentation at the Future Internet Assembly – Session 2.4, October 2011, Poznan, Poland.
- V. Gonçalves, M. Stamatelatos and S. Delaere: "Management issues in virtualisation business scenarios" presentation at the Future Internet Assembly – Session 1.1, October 2011, Poznan, Poland.
- M. Stamatelatos: "Value Creation, Value flows and liability over virtual resources: Infrastructure Perspective, The Idea, The Scope, The expectations", presentation at the Future Internet Assembly – Session 1.1, October 2011, Poznan, Poland.
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- A. Bantouna, K. Tsagkaris, V. Stavroulaki, P. Demestichas, A. Manzalini: "Implementations of Machine Learning Techniques on Autonomic/Cognitive Networking", presentation at the LCCN meeting during IETF 82, November 2011, Taipei, Taiwan.
- O. Festor: Keynote at the Future Internet Architecture Workshop (FIArch), February 2012, Brussels, Belgium.
- A. Galis: Keynote at the Future Internet Architecture Workshop (FIArch), February 2012, Brussels, Belgium.
- M. Gruber: "Traffic Management in the European Project UniverSelf, presentation at the VDE/ITG 5.2.4 meeting on “Mobile Traffic Management”, March 2012, Munich, Germany.
- K.Tsagkaris: "Standardization of a Unified Management Framework", presentation at the Standards brokerage event of FIA Aalborg, May 2012, Aalborg, Denmark.
- Z. Altman: "Coordination of self-optimizing functionalities in LTE networks", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- N. Alonistioti: "An Efficient Load balancing Scheme for Network Stability in Future Networks", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- A. Manzalini: "Utility Functionals for Optimization and Stability of Future Networks", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- G. Poulios: "Knowledge in Support of Congestion Control Mechanisms", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.

- A. Manzalini: "Stability in Future Networks", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- S. Clayman: "Stability in Dynamic Networks", presentation at the Future Network Stability workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- G. Nguengang: "UMF: A Unified Management Framework", presentation at the Federation II workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- B. Fuentes: " Bringing UMF to Reality: a Network and Service Governance Use Case", presentation at the Federation II workshop – part of the Future Networks and Mobile Summit, June 2012, Berlin, Germany.
- A. Manzalini: "Towards Software Networks… and beyond", presentation at the 1st CTTE Workshop on Network Operators View on Future Networks Landscape: Will it be Cloudy with a Chance of Data Rain?, June 2012, Athens, Greece.
- M. Liinasuo: "Human network management and trust on self-x functionalities", presentation at the 1st CTTE Workshop on Network Operators View on Future Networks Landscape: Will it be Cloudy with a Chance of Data Rain?, June 2012, Athens, Greece.
- A. Galis: "Towards Self-management in Software Driven Networks", keynote at the Self-managing and Autonomous Networks workshop (SAN 2012), part of the 24th International Teletraffic Congress (ITC 24), September 2012, Krakow, Poland.

Annex B – First UniverSelf press release

Press release

Paris, France, December 22, 2010

Leading European communications companies and research organizations join forces to launch the UniverSelf project as part of the Future Networks 7th Framework Program

Focus on Automating Future Networks

A group of 17 leading European telecommunications service providers, IT corporations, infrastructure vendors and academic institutions have launched "UniverSelf" a research initiative whose goal is to overcome the increasing complexity of managing communication networks and enable their future growth by generating innovations in autonomic networking – technologies that enable networks to manage themselves.

The solutions "UniverSelf" creates will benefit the European ICT industry by creating new business opportunities and standards, benefit EU citizens by improving Quality of Service and improving performance, and benefit telecommunications service providers and network operators by reducing time-to-market and increasing savings in operational expenditure through the optimization of human resources and a reduction in manual errors.

"UniverSelf" is supported within the scope of the European Union's 7th Framework Programme for Research and Technological Development (FP7) from which it has received 10M€ funding. UniverSelf will last 36 months (2010-2013) and take advantage of the diverse expertise and complementary skills of its members who represent the following corporations and research institutions from across the ICT industry:

Alcatel-Lucent (Project Coordinator), France Telecom (Technical Manager), Telecom Italia (IT), Telefonica I+D (ES), NEC Europe (DE), Thales Communications (FR), Fraunhofer FOKUS (DE), IBBT Interdisciplinary Institute For Broadband Technology (BE), INRIA Institut National de Recherche en Informatique et en Automatique (FR), VTT Valtion Teknillinen Tutkimuskeskus (FI), UCL University College London (UK), UNIS University of Surrey (UK), NKUA National and Kapodistrian University of Athens (GR), UPRC University of Piraeus Research Center (GR), UT Universiteit Twente (NL)

The research program has four objectives:

1/ Design a Unified Management Framework for the different existing and emerging architectures, that is cross-technology (i.e. wireless and wireline) and will serve as a common platform for both systems and services.

2/ Design the functions that will enable self-managing networks and embed these functions directly within the systems and elements that comprise the network infrastructure and support service delivery.

3/ Demonstrating the potential for deployment of autonomic solutions in carrier grade networks with an eye towards stimulating further research in Europe towards application and commercialization.

4/ Generate confidence in the viability and use of autonomic technologies in telecommunication networks by defining "certification" parameters for autonomic networking products.

Martin Vigoureux, Research Director at Bell Labs and Project Coordinator, says: *"It is time to take self-management to the next level. UniverSelf, driven by customer needs and focused on the industrial impact of research, is an ideal instrument to start engineering autonomics and make them a reality in operational networks. Numerous challenges lie ahead but delivering efficient, converged and trustworthy solutions, together with the appropriate standards, is essential to reach true operational benefits and wide deployments."*

Christian Destré, Project Leader at France Telecom-Orange Labs and Project Technical Manager, says: *"From the operator viewpoint, Self-management technologies act as enablers to face the increasing operational management complexity due to networks convergence, usage revolution with the exploding number of IP-based devices and services, and network and service role evolutions related to the Future Internet. Confident unification and standardization are required for a broad adoption and deployment in operational environments."*

Antonio Manzalini, Project Manager at Telecom Italia says: *"Future networks are likely to evolve towards pervasive environments of link, processing and storage resources and services; virtualization, enabling multiple logical networks to co-exist on top of a same physical infrastructure, will offer new business opportunities but it will increase management complexity even more. Autonomic self-management might be essential part of this vision, considering also that these future networks have to be managed in highly dynamic and unpredictable contexts. At the end of the day, reducing OPEX and enabling new sources of revenues (also with new business models) will decrease the investment risks for Operators."*

Jose Antonio Lozano-Lopez, Autonomic Communications Division Manager at Telefonica, says: *"Autonomic infrastructure is going to change some of the well established current networking and management paradigms. After some years of successful research, it is the moment to boost autonomics into real operational environments. UniverSelf pragmatic approach to autonomic will provide not only the networking procedures, but also the governance methods and tools to dramatically decrease OPEX on Operators' operational processes."*

UniverSelf was launched in Villarceaux, France in the premises of Alcatel-Lucent Bell Labs.

Project Website: www.univerself-project.eu

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Annex C – Summary of the first workshop on "Network Federation"

The joint ONE – ONEFIT – UNIVERSELF workshop on “Federation” initiated by UniverSelf and held at the 20th edition of the Future Network and Mobile Summit in Warsaw, Poland has been a fair success and attracted more than 45 attendees during the 4 sessions. The workshop consisted of thematic technically-focused sessions and a closing panel to debate on the notion of Federation for the networks of the future.

Workshop Overview

The different types of networks available, the range of networking technologies, variety of traffic types with their individual requirements in terms of QoS and security and finally the number of administrative domains that separate the networks produces a rather complex communication system. This complexity affects the access and core network as well as the high speed backbone, and managing the resources of all of these efficiently has yet to be accomplished.

Federation of the currently used approaches and complementing them with new management methods will help overcoming the structural limitations of the communication infrastructures and their management systems. Networks should be managed to be able to allow dynamic, efficient and scalable support of the vast set of user requirements and of applications across federated administrative and technology domains.

The workshop discussed the different approaches that are investigated in the ICT FP7 projects OneFIT, UniverSelf and One. The aim was to work out how the integration and interworking problems can be solved, how networks and their management can be federated using the approaches investigated in the three projects. The aim of the workshop was to exploit complementarities between the approaches and to identify any potential omissions when looking at the whole network from access, core to backbone.

Workshop Organisers

The workshop was organised jointly by the three FP7 projects UniverSelf (http://www.univerself-project.eu/), OneFIT (http://www.ict-onefit.eu/) and One (http://www.ict-one.eu/). The organisation committee included Laurent Ciavaglia and Samir Ghamri-Doudane (representing UniverSelf), Panagiotis Demestichas and Klaus Moessner (representing OneFIT) and Admela Jukan (representing One).

The discussions were on an advanced technical level, after a round of introductions of the main concepts, and in particular an overview of how federation will be approached by each of the projects, more detailed presentations and a panel discussion followed.

Workshop Objectives

The workshop primarily intended to raise further awareness about the problem, but also about the solution approaches being followed. It aimed to help gaining awareness in industry and to identify the most pressing matters in terms of areas for industry consensus.

The second aim was to inspire other researchers and projects to collaborate and contribute to the solution of the problems that UniverSelf, OneFIT and One are tackling. Finally, it was expected to not only federate the networks and management systems of networks, but also to facilitate a more common approach to overcome the complexity and management problem, not only across the organizing projects, but also with other projects that attended the workshop. The outcomes may be discussed in concertation or cluster meetings.

Workshop Agenda and Presenters

The workshop was structured in four parts, distributed over two sessions. The workshop was chaired by Klaus Moessner (University of Surrey), and the Panel session was moderated by Antonio Manzalini (Telecom Italia).

Part A “The Management Challenge”: Overview of the Approaches

Chaired by: Klaus Moessner, University of Surrey, United Kingdom.

A.1: UniverSelf – A Unified Management Framework for Operator - Governed Networks and Services.

By: Gerard Nguengang, THALES Communications, France.

A.2: OneFIT - Opportunistic Networks for Efficient Application Delivery in the Future Internet.

By: Jens Gebert, Alcatel-Lucent Deutschland, Bell Labs, Germany.

A.3: One - An IP and Transport Layer Management Ecosystem.

By: Mohit Chamania, TU Braunschweig, Germany.

Part B "Management Systems"

Chaired by: Klaus Moessner, University of Surrey, United Kingdom.

B.1: UniverSelf – Network Empowerment - Finding the Right Key to the Lock.

By: Markus Gruber, Alcatel-Lucent, Germany.

B.2: OneFIT - Algorithms for Opportunistic Network Management and Infrastructure Coordination.

By : Oriol Sallent, Universitat Politecnica de Catalunya, Spain.

B.3: ONE - Architecture and Cooperation with External Components and Management Systems.

By: Maciej Maciejewski, ADVA Optical Networking, Poland.

Part C: Federation Approaches and Way Forward

Chaired by: Antonio Manzalini, Telecom Italia , Italy.

C.1: UniverSelf – Role and Impact of Autonomics in a Federated Eco-system.

By : Laurent Ciavaglia, Alcatel-Lucent France, France.

C.2: OneFIT - Control Channels for the Cooperation of Cognitive Management Systems.

By: Marcin Filo, Wroclawskie Centrum Badan EIT, Poland.

C.3: ONE - Federation Use Cases.

By: Oscar Gonzalez de Dios, Telefonica I+D, Spain.

Part D: Panel "Network Federation - Way Forward“

Moderated by: Antonio Manzalini, Telecom Italia , Italy.

Laurent Ciavaglia, Alcatel-Lucent France, France (UniverSelf)

Prof. Panagiotis Demestichas, University of Piraeus, Greece (OneFIT)

Oscar Gonzalez de Dios, Telefonica I+D, Spain (One)

Annex D – Summary of the second workshop on "Network Federation"

The workshop was held as two special sessions during the Future Networks and Mobile Summit 2012, from July 4th to July 6th, in Berlin, Germany. It was chaired by Klaus Moessner (University of Surrey).

Event information, including the overall conference programme as well as the detailed special sessions/workshop programme is available at the following link: http://www.futurenetworksummit.eu/2012/, The actual list of presentations given during the workshop can be seen here.

The two sessions (second link) concentrated on architecture and algorithms and proof of concepts, respectively. The sessions were:

Workshop session 9b: Network Federation I - Architecture
Chair: Klaus Moessner, University of Surrey, United Kingdom

Opening Keynote - Standardising Autonomous Networks: ETSI AFI
Laurent Ciavaglia, Alcatel-Lucent bell Labs, France

UniverSelf: UMF - A Unified Management Framework
Gerard Nguengang Fanmegne, THALES COMMUNICATIONS SA, France

OneFIT: An Architecture for operator governed opportunistic networking
Jens Gebert, Alcatel-Lucent Deutschland, Bell Labs, Germany

GEYSERS: An architecture and a Service Delivery Framework for operating and offering services over Virtual Infrastructures
Sergi Figuerola, i2CAT, Spain

Workshop 10b: Network Federation II - Algorithms & Proof of Concept
Chair: Klaus Moessner, University of Surrey, United Kingdom

UniverSelf: Bringing UMF to Reality: a Network and Service Governance Use Case
Beatriz Fuentes, TID, Spain

OneFIT: Algorithms for Opportunistic Network Management and Infrastructure Coordination
Jordi Perez-Romero, Universitat Politecnica de Catalunya (UPC), Spain

ONE: Prototyping the ONE: Architecture and Implementation
Mohit Chamania, TU Braunschweig, Germany

GEYSERS: The LICL: a prototype for the composition of Logical Infrastructures
Joan A. García-Espín, i2CAT, Spain

The workshop did give a good overview on the architectures and main algorithms that are being investigated in the four partaking projects. The presentations clearly identified the different approaches towards federation of networks, while there is quite some complementarity, there are quite a number of competing concepts and algorithms that are being followed in the different projects. The slide sets/presentations (available from the conference page) provide a good overview on these techniques.

Annex E – Summary of the workshop on "Future Network Stability: Threats and Challenges"

The workshop has been organized in the context of Future Network and Mobile Summit, July 2012 in Berlin, Germany. It was chaired by Antonio Manzalini (Telecom Italia). The program included 7 presentations.

Workshop Overview and Objectives

The Workshop has addressed the issue of stability in future networks. Presentations and discussions considered the stability challenges concerning the evolution of future networks towards dynamical complex and ubiquitous infrastructures, being managed and controlled by pieces of S/W (implementing self-* features) interacting each other… and intertwined with human actions. In particular, dynamics of these networks may bring them to states of high instability or vulnerability which need to be anticipated and tamed via real-time stability monitoring and control.

Workshop Program and presentation abstracts

During the workshop the following presentations have been made:

Title: Utility Functionals for Optimization and Stability of Future Networks

Speaker: Antonio Manzalini (Telecom Italia)

Abstract: Complexity of network management is dramatically increasing as networks are progressively becoming more heterogeneous, ubiquitous and dynamic. This paper starts by describing a future network scenario characterized by the interworking of myriads of sub-networks and nodes, run by diverse Players. In order to master this complexity, this paper proposes that network optimization and stability should be ensured through maximizing (minimizing) utility functionals across the entire network specifically related to its structure, features and business objectives (and subject to specific constraints). This approach would allow both to take account of transients behaviours of network dynamics and to ensure, at the same time, (distributed closed loop) stability. Paper concludes arguing the need of developing a Network Functional Theory in order to define a systemic methodology dealing with utility functionals for future networks.

Title: Knowledge in Support of Congestion Control Mechanisms

Speaker: Aimilia Bantouna (University of Piraeus)

Abstract: Today's large development of networks increases their complexity in levels which sometimes become difficult to manage. An often proposed way for addressing this issue is to enable networks with cognitive/ autonomic capabilities usually achieved by Self-x mechanisms. Although these mechanisms can receive autonomic decisions given the past experience of the system and its current state they are not in position to ensure stability of the system. On the other hand, network instabilities should be avoided as they may lead to both worse network performance and higher utilization of resources. This paper studies the problem of network stability by defining it and identifying some of the basic reasons that may lead to it. Moreover, focusing on instabilities that come from congestion control mechanisms, a learning based method is proposed for enhancing their decisions and thus increasing network stability. In particular, the unsupervised learning technique of Self-Organizing Maps (SOMs) is used as basis for building knowledge on the performance of the congestion control mechanism TCP Vegas. This knowledge is then used for "consulting" the congestion control mechanism when adjusting for enhancing its functionality and avoiding congestion in a more stable way. The first tentative results suggest that this kind of knowledge may indeed enhance the performance of TCP Vegas by eliminating some of its drawbacks and by assisting the latter to work in a way that allows higher and more stable network utilization.

Title: Coordination of self-optimizing functionalities in LTE networks

Speaker: Zwi Altman (France Telecom)

Abstract: Self-organizing network (SON) mechanisms encompassing self-configuration, self-optimization and self-healing have been introduced in LTE to simplify the network management, reduce its cost of operation and increase its performance. The coordination of self-optimizing functionalities is essential to ensure stability and to achieve the performance gain expected from the SON technology. This presentation will explain the stability dilemma related to the activation of multiple control loops which self-optimize the LTE network. Possible solutions for the coordination problem will be examined, and the condition for stability and convergence will be explained. A use case of two self-optimizing functionalities operating simultaneously in a LTE-Advanced heterogeneous network (HetNet) with macro- and relay stations will be presented: Coverage and capacity optimization and traffic balancing of resources between the wireless backhaul links and the direct (macro- and relay) station to mobile links. A real-time demonstration of the coordination process performed on a dynamic network simulator will be shown. This work is carried out in the UniverSelf FP7 project.

Title: Stability in Dynamic Networks

Speaker: Stuart Clayman (University College of London)

Abstract: This paper discusses the issues of stability within dynamic networks, and in particular we try to understand what stability is within this context. Traditionally networks have been viewed as being a relatively stable layer over which traffic is routed. The traffic flows and the routing updates have been sources of instability. Recently, a large number of emerging and proposed networks have had the common characteristic of being dynamic in the sense that links and/or nodes can appear and disappear on a very short time scale (seconds or minutes). Such networks present a particular challenge in terms of the analysis of stability. In addition to the traditional routes by which instability can arise in a network these networks have new modes by which instability can arise. This paper discusses these new forms of instability and potential issues that may arise.

Title: Distributed control loops: towards a cooperative autonomic management framework for the Future Internet

Speaker: Steven Latre (University of Gent, INTEC)

Abstract: In the design of the Future Internet, there is a clear evolution toward autonomic and cognitive self-management approaches, which introduce a higher level of intelligence in the (management of the) network to allow a greater and more flexible response to changing context in terms of network status (e.g., packet loss, failure of a node), user behaviour (e.g., flash crowds) and service support (e.g., increasing QoS and resource requirements of servers). Therefore, future networks are evolving towards more self-governing entities that autonomically decide on the most optimal actions to undertake. As such, they require the deployment of intelligent components, often called autonomic elements, that govern this autonomic decision making process. Centralizing this autonomic decision making process in the Future Internet is not possible both from a scalability and business perspective. Instead, autonomic elements are typically distributed across the network and need to cooperate with each other to ensure an end-to-end management solution. Without any cooperation or orchestration between the autonomic elements, the taken decisions are prone to instability caused by oscillations in the decision (e.g., one autonomic element responding to the decision of another and vice versa) or counteracting autonomic elements. In this talk, we discuss the design of a set of distributed but cooperating control loops. We focus on how different autonomic elements can cooperate with each other to ensure end-to-end QoE guarantees of a multimedia service. More specifically, we will discuss how different parts of control loops can be offloaded and distributed and how the use of semantic information (e.g., through ontologies and contract design) can aid in increasing the trust of the reasoning process and thus avoiding instability.

Title: Network Stability based on Distributed Constraints Systems

Speaker: Septimiu Nechifor (Siemens)

Abstract: Constraints Programming represents "de facto" solution for very large scale configurations. In the last years Cognitive and Autonomic Computing & Networking proposed solutions who lead most of the time to the

construction of planes for knowledge management and cognitive solutions based on algorithmic. Since the volume of involved nodes and ephemeral configuration explodes, as the cases from Internet of Things area, the cost of maintenance of specialized control structures grow also. Constraints programming techniques comes in the scene in order to automatically solve complex dependencies between behavioral aspects of nodes encapsulated in autonomic functionalities, and to insure the cooperative behavior expected from an overall cognitive profile.

Title: An Efficient Load balancing Scheme for Network Stability in Future Networks

Speaker: Damianos Kypriadis, Eleni Patouni (National & Kapodistrian University of Athens)

Abstract: In the highly dynamic, pervasive, environment of Future Networks, the numbers of users' devices, the number and sophistication of communication services and applications, the traffic/information flows as well as the interconnected real and virtual resources accelerate at a fast rate with unmet scalability levels. From such developments arise major challenges including network performance and stability. Specifically, the generated traffic drives the network operation to its edge; the resources saturation may also lead to inability to serve the user demands. This fact tends to be more sharpened in future networks as the user penetration augments abruptly and the environmental conditions change rapidly. As a result, different instability regions may occur within the network management and control mechanisms, e.g. in resources provisioning, flow and admission control. Here we deal with such network instability focusing on the load balancing problem. We introduce a feedback-loop based mechanism for alleviating traffic congestion and overutilization of resources in a LTE wireless system through online optimization and configuration actions. The proposed model targets a more effective use of the resources (e.g. bandwidth) with regards to number of serving users and provided QoS. A reactive controller based on parameters such as bandwidth or network response time is used in order to optimize the performance of the system. Simulations using Matlab optimization toolbox are applied for assessing the proposed mechanism.

Annex F – Summary of the first internal technical workshop

The first UniverSelf-internal technical workshop (coordinated by INRIA) has been organized during the project plenary in February 2012 (Paris, France). The workshop covered mainly topics in the context of WP3 (network empowerment methods and mechanisms). The program included the following presentations (workshop agenda):

TECHNICAL WORKSHOP starts at 09:30		
09:30-09:40	Workshop Introduction	Eric Fabre (INRIA) & Markus Gruber (ALUD)
09:40-10:00	Human network management and self-x functionalities	Marja Liinasuo (VTT)
10:00-10:20	SON interactions	Markus Gruber (ALUD)
10:20-10:40	Robust learning technique with application to heterogeneous LTE network with relay stations	Richard Combes (Orange)
10:40-11:00	A policy-based framework for SON coordination	Xavier Gelabert (Orange)
11:00-11:20	Coffee break	
11:20-11:40	Optimization of context acquisition and dissemination using a distributed data mining framework	Eleni Patouni (NKUA)
11:40-12:10	Unsupervised machine learning for enhanced congestion control	Aimilia Bantouna (UPRC)
12:10-12:40	Load-aware EPC instantiation	Zarrar Yousaf (NEC)
12:40-14:00	Lunch break	
14:00-14:20	Load balancing solutions for combined access selection and service migration	Teemu Rautio (VTT)
14:20-14:40	QoS-based fault management in IP networks and IMS services	Makis Stamatelatos (NKUA)
14:40-15:00	Combining Bayesian networks and case-based reasoning for optimized fault diagnosis	Leila Bennacer (ALBLF)
15:00-15:30	Self-diagnosis based on causal graphs	Christophe Dousson (FT)
15:30-15:50	Principles of self-modelling towards model-based network and service diagnosis	Carole Hounkonnou (INRIA)
15:50-16:20	Coffee break	
16:20-16:40	Application of probabilistic procedures to fiber-to-the-home network management	Beatriz Fuentes (TID)
16:40-17:00	Increasing Vulnerability Awareness in Autonomic Networks and Systems with OVAL	Martin Barrere (INRIA)
17:00-17:20	Towards verification for distributed vulnerabilities	Stefan Haar (INRIA)
17:20-17:40	Network morphing	Magali Prunaire (ALBLF)
17:40-18:00	Towards an embedding into the UMF	Laurent Ciavaglia (ALBLF)
Workshop ends at 18:00		